



# INNOLUX DISPLAY CORPORATION

## MT230DW01 V.3 LCD MODULE SPECIFICATION

( ) Preliminary Specification

( ● ) Final Specification

| Customer | Checked and Approved by |
|----------|-------------------------|
|          |                         |

| <i>Approved by</i> | <i>Checked by</i> | <i>Prepared by</i> |
|--------------------|-------------------|--------------------|
|                    |                   |                    |

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## Record of Revision

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**A. General specification**

| NO. | Item                       | Specification                           | Remark |
|-----|----------------------------|-----------------------------------------|--------|
| 1   | Display resolution (pixel) | 1,920(H) X 1,080(V), Full HD            |        |
| 2   | Active area (mm)           | 509.184(H) x 286.416(V)                 |        |
| 3   | Screen size (inch)         | 23 inches diagonal                      |        |
| 4   | Pixel pitch (mm)           | 0.2652(H) X 0.2652(V)                   |        |
| 5   | Color configuration        | R, G, B vertical stripe                 |        |
| 6   | Overall dimension (mm)     | 534mm(H) x 311.7mm(V) 8.9mm(D) (Typ.)   |        |
| 7   | Weight (g)                 | 2200 (Max)                              |        |
| 8   | Surface treatment          | Anti-Glare, Haze=25%, Hard coating (3H) |        |
| 9   | Input color signal         | 8 bit LVDS                              |        |
| 10  | Display colors             | 16.7M (6 bit with Hi-FRC)               |        |
| 11  | Color Saturation           | 80% NTSC                                |        |
| 12  | Optimum viewing direction  | 6 o'clock                               |        |
| 13  | Backlight                  | White LED                               |        |
| 14  | RoHS & Halogen Free        | RoHS & Halogen Free compliance          |        |



## B. Electrical specifications

### 1. Pin assignment

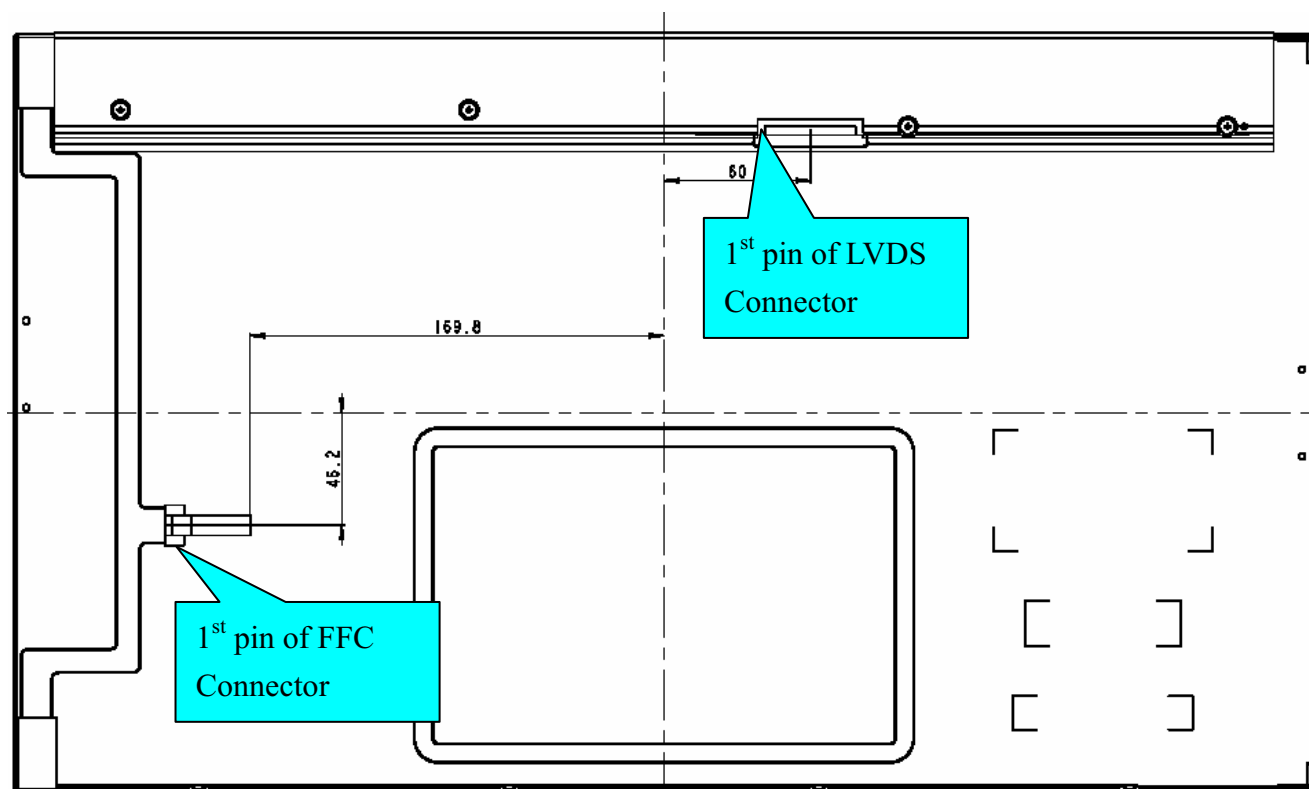
#### 1.1. LVDS Connector

FOXCONN GS23302-0311S-7F or mechanical interface equivalent connector.

| No | Symbol | Description                               |
|----|--------|-------------------------------------------|
| 1  | RxO0-  | LVDS Differential data input Channel 0(-) |
| 2  | RxO0+  | LVDS Differential data input Channel 0(+) |
| 3  | RxO1-  | LVDS Differential data input Channel 1(-) |
| 4  | RxO1+  | LVDS Differential data input Channel 1(+) |
| 5  | RxO2-  | LVDS Differential data input Channel 2(-) |
| 6  | RxO2+  | LVDS Differential data input Channel 2(+) |
| 7  | GND    | Ground                                    |
| 8  | RxOC-  | LVDS Differential Clock input (-)         |
| 9  | RxOC+  | LVDS Differential Clock input (+)         |
| 10 | RxO3-  | LVDS Differential data input Channel 3(-) |
| 11 | RxO3+  | LVDS Differential data input Channel 3(+) |
| 12 | RxE0-  | LVDS Differential data input Channel 0(-) |
| 13 | RxE0+  | LVDS Differential data input Channel 0(+) |
| 14 | GND    | Ground                                    |
| 15 | RxE1-  | LVDS Differential data input Channel 1(-) |
| 16 | RxE1+  | LVDS Differential data input Channel 1(+) |
| 17 | GND    | Ground                                    |
| 18 | RxE2-  | LVDS Differential data input Channel 2(-) |
| 19 | RxE2+  | LVDS Differential data input Channel 2(+) |
| 20 | RxEC-  | LVDS Differential Clock input (-)         |
| 21 | RxEC+  | LVDS Differential Clock input (+)         |
| 22 | RxE3-  | LVDS Differential data input Channel 3(-) |
| 23 | RxE3+  | LVDS Differential data input Channel 3(+) |
| 24 | GND    | Ground                                    |
| 25 | NC     | No Connection                             |
| 26 | NC     | No Connection                             |
| 27 | NC     | No Connection                             |
| 28 | VCC    | Power supply (+5.0V)                      |
| 29 | VCC    | Power supply (+5.0V)                      |
| 30 | VCC    | Power supply (+5.0V)                      |

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## 1.2 LED Light Bar FFC Cable

| Pin No | Symbol | Description      |
|--------|--------|------------------|
| 1      | RTN 1  | Feedback         |
| 2      | RTN 2  | Feedback         |
| 3      | RTN 3  | Feedback         |
| 4      | RTN 4  | Feedback         |
| 5      | NC     |                  |
| 6      | VIN 1  | LED power supply |
| 7      | VIN 2  | LED power supply |
| 8      | NC     |                  |
| 9      | RTN 5  | Feedback         |
| 10     | RTN 6  | Feedback         |
| 11     | RTN 7  | Feedback         |
| 12     | RTN 8  | Feedback         |

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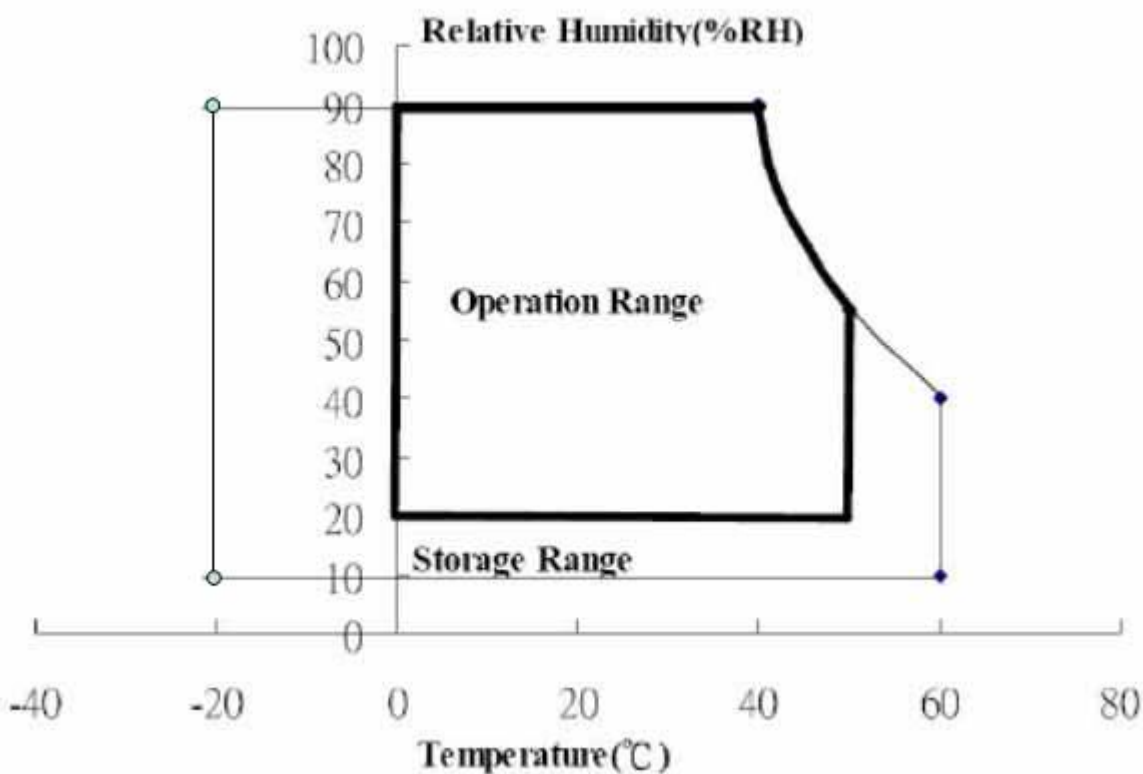
## 2. Absolute maximum ratings

| Parameter             | Symbol   | Values |      |      | Unit | Remark  |
|-----------------------|----------|--------|------|------|------|---------|
|                       |          | Min.   | Typ. | Max. |      |         |
| Power voltage         | $V_{CC}$ | -0.3   | -    | 6.0  | V    | At 25°C |
| Input signal voltage  | $V_{LH}$ | -0.3   | -    | 4.3  | V    | At 25°C |
| Operating temperature | $T_{op}$ | 0      | -    | 50   | °C   | Note 1  |
| Storage temperature   | $T_{ST}$ | -20    | -    | 60   | °C   | Note 2  |

Note 1: The relative humidity must not exceed 90% non-condensing at temperatures of 40°C or less.

At temperatures greater than 40°C, the wet bulb temperature must not exceed 39°C.

Note 2: The unit should not be exposed to corrosive chemicals.



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## 3. Electrical characteristics

## a. Typical operating conditions

| Item                          |                            | Symbol     | Min. | Typ. | Max. | Unit  | Remark    |
|-------------------------------|----------------------------|------------|------|------|------|-------|-----------|
| Input Voltage                 |                            | $V_{CC}$   | 4.5  | 5    | 5.5  | V     |           |
| Permissive Power Input Ripple |                            | $V_{RF}$   | -    | -    | 400  | mVp-p |           |
| Input Current                 | Black                      | $I_{CC}$   | -    | 1000 | -    | mA    | Note 1    |
|                               | White                      | $I_{CC}$   | -    | 800  | -    |       | Note 2    |
|                               | Mosaic                     | $I_{CC}$   | -    | 950  | -    |       | Note 3    |
| Rush Current                  |                            | $I_{Rush}$ | -    | 1.6  | 3    | A     | Note 4    |
| Logic Input                   | Common Mode Voltage        | VCM        | -    | 1.2  | -    | V     |           |
| Voltage<br>LVDS:<br>IN+, IN-  | Differential Input Voltage | VID        | 100  | -    | 600  | mV    |           |
|                               | Threshold Voltage (High)   | VTH        | -    | -    | 100  | mV    | Note 5, 6 |
|                               | Threshold Voltage (Low)    | VTL        | -100 | -    | -    | mV    | Note 5, 6 |

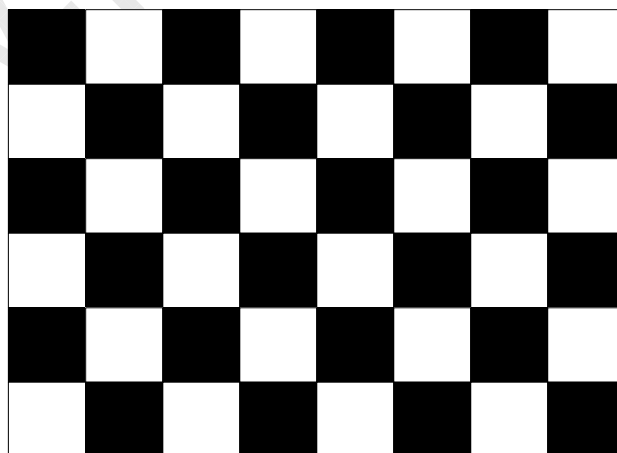
Note 1: The specified current is under the  $V_{CC} = 5V$ ,  $25^{\circ}C$ ,  $f_v = 60Hz$  (frame frequency) condition whereas black pattern is displayed.

Note 2: The specified current is under the  $V_{CC} = 5V$ ,  $25^{\circ}C$ ,  $f_v = 60Hz$  (frame frequency) condition whereas white pattern is displayed.

Note 3: The specified current is under the  $V_{CC} = 5V$ ,  $25^{\circ}C$ ,  $f_v = 60Hz$  (frame frequency) condition whereas mosaic pattern (black & white [8\*6]) is displayed.

White: 255 Gray

Black: 0 Gray



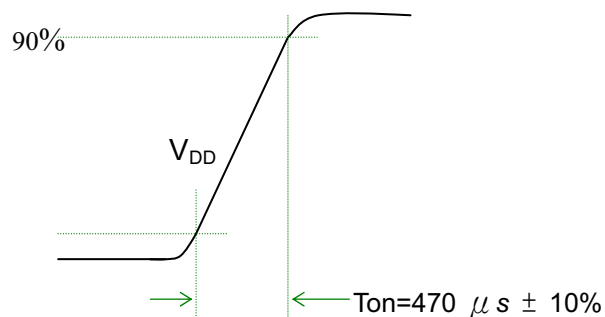


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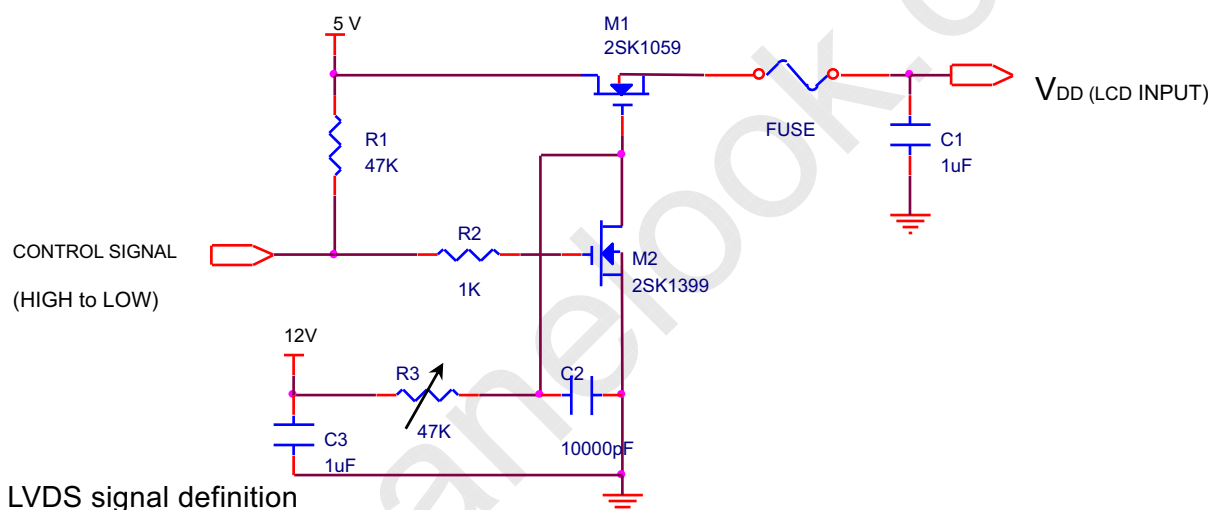
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Note 4: Test condition:

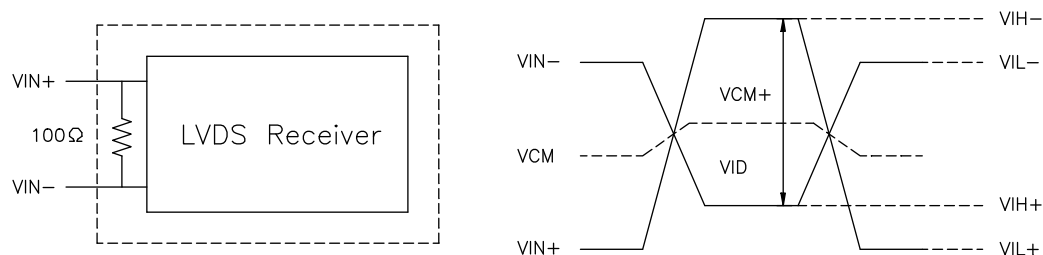
- (1).  $V_{DD} = 5\text{ V}$ ,  $V_{DD}$  rising time =  $470\text{ }\mu\text{s} \pm 10\%$
- (2). Pattern: Mosaic pattern



(3) Test circuit

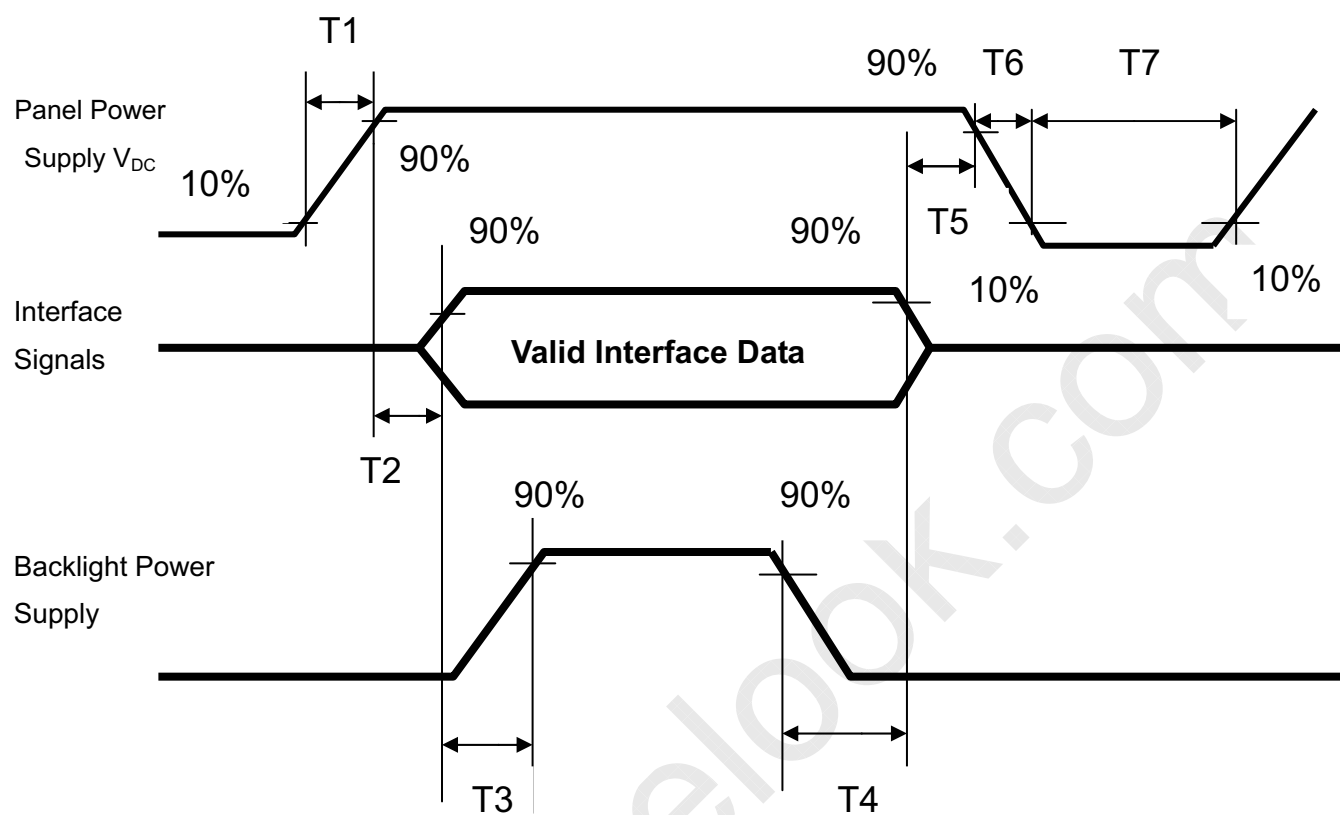


Note 5: LVDS signal definition

 $VIN+$  = Positive differential DATA & CLK Input $VIN-$  = Negative differential DATA & CLK Input $VID = VIN+ - VIN-$ , $\Delta VCM = |VCM+ - VCM-|$ , $\Delta VID = |VID+ - VID-|$ , $VID+ = |VIH+ - VIH-|$ , $VID- = |VIL+ - VIL-|$ , $VCM = (VIN+ + VIN-)/2$ , $VCM+ = (VIH+ + VIH-)/2$ , $VCM- = (VIL+ + VIL-)/2$ ,

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Note 6: Power on sequence for LCD  $V_{DD}$ 

| Parameter | Value |      |     | Unit |
|-----------|-------|------|-----|------|
|           | Min   | Typ. | Max |      |
| T1        | 0.1   | -    | 10  | ms   |
| T2        | 0     | 30   | 50  | ms   |
| T3        | 200   | 250  | -   | ms   |
| T4        | 100   | 250  | -   | ms   |
| T5        | 0     | 20   | 50  | ms   |
| T6        | 0.1   | -    | 10  | ms   |
| T7        | 1000  | -    | -   | ms   |



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## b. Display color vs. input data signals

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

| Color        |                  | Input color data |    |    |    |     |    |    |    |       |    |    |    |     |    |    |    |      |    |    |    |     |    |    |    |
|--------------|------------------|------------------|----|----|----|-----|----|----|----|-------|----|----|----|-----|----|----|----|------|----|----|----|-----|----|----|----|
|              |                  | Red              |    |    |    |     |    |    |    | Green |    |    |    |     |    |    |    | Blue |    |    |    |     |    |    |    |
|              |                  | MSB              |    |    |    | LSB |    |    |    | MSB   |    |    |    | LSB |    |    |    | MSB  |    |    |    | LSB |    |    |    |
|              |                  | R7               | R6 | R5 | R4 | R3  | R2 | R1 | R0 | G7    | G6 | G5 | G4 | G3  | G2 | G1 | G0 | B7   | B6 | B5 | B4 | B3  | B2 | B1 | B0 |
| Basic colors | Black            | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Red(255)         | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Green(255)       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Blue(255)        | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|              | Cyan             | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|              | Magenta          | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
|              | Yellow           | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | White            | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |
| Red          | Red(000) dark    | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Red(001)         | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Red(002)         | 0                | 0  | 0  | 0  | 0   | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | :                | :                | :  | :  | :  | :   | :  | :  | :  | :     | :  | :  | :  | :   | :  | :  | :  | :    | :  | :  | :  | :   | :  | :  | :  |
|              | Red(253)         | 1                | 1  | 1  | 1  | 1   | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Red(254)         | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Red(255) bright  | 1                | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| Green        | Green(000)dark   | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Green(001)       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Green(002)       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | :                | :                | :  | :  | :  | :   | :  | :  | :  | :     | :  | :  | :  | :   | :  | :  | :  | :    | :  | :  | :  | :   | :  | :  | :  |
|              | Green(253)       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Green(254)       | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Green(255)bright | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1   | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
| Blue         | Blue(000) dark   | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 0  |
|              | Blue(001)        | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 0  | 1  |
|              | Blue(002)        | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0   | 0  | 1  | 0  |
|              | :                | :                | :  | :  | :  | :   | :  | :  | :  | :     | :  | :  | :  | :   | :  | :  | :  | :    | :  | :  | :  | :   | :  | :  | :  |
|              | Blue(253)        | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 0  | 1  |
|              | Blue(254)        | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 0  |
|              | Blue(255) bright | 0                | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0   | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1   | 1  | 1  | 1  |

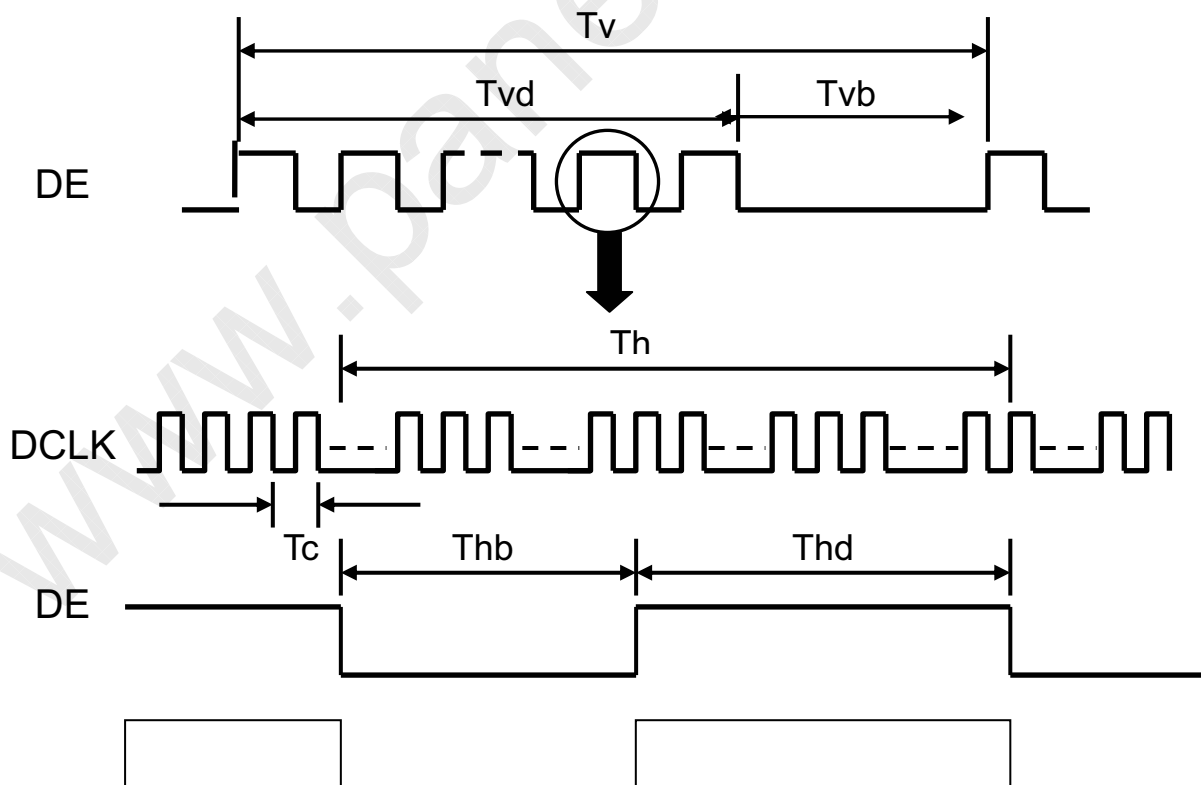
### c. Input signal timing

## Support Input Timing Table

|            | Item                 | Description          | Min.  | Typ.  | Max. | Unit                 |
|------------|----------------------|----------------------|-------|-------|------|----------------------|
| Clock      | Dclk                 | period               | 11.43 | 13.89 | 16.7 | nS                   |
|            |                      | frequency            | 60    | 72    | 87.5 | MHz                  |
| Vertical   | T <sub>V_TOTAL</sub> | V total line number  | 1090  | 1100  | 1160 | T <sub>H_TOTAL</sub> |
|            | T <sub>V_DATA</sub>  | Data duration        | 1080  | 1080  | 1080 | T <sub>H_TOTAL</sub> |
|            | T <sub>VB</sub>      | V-blank              | 10    | 20    | 80   | T <sub>H_TOTAL</sub> |
|            | f <sub>V</sub>       | frequency            | 50    | 60    | 75   | Hz                   |
| Horizontal | T <sub>H_TOTAL</sub> | H total pixel number | 1000  | 1088  | 1120 | DClk                 |
|            | T <sub>H_DATA</sub>  | Data duration        | 960   | 960   | 960  | DClk                 |
|            | T <sub>HB</sub>      | H-blank              | 40    | 128   | 160  | DClk                 |

Note: Because this module is operated by DE mode only, Hsync and Vsync input signals should be set to low Logic level or ground. Otherwise, this module would operate abnormally.

## INPUT SIGNAL TIMING DIAGRAM



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## d. Display Position

|           |           |        |             |        |              |              |
|-----------|-----------|--------|-------------|--------|--------------|--------------|
| D(1,1)    | D(2,1)    | ... .. | D(960,1)    | ... .. | D(1919,1)    | D(1920,1)    |
| D(1,2)    | D(2,2)    | ... .. | D(960,2)    | ... .. | D(1919,2)    | D(1920,2)    |
| ⋮         | ⋮         | ... .. | ⋮           | ... .. | ⋮            | ⋮            |
| D(1,540)  | D(2,540)  | ... .. | D(960,540)  | ... .. | D(1919,540)  | D(1920,540)  |
| ⋮         | ⋮         | ... .. | ⋮           | ... .. | ⋮            | ⋮            |
| D(1,1079) | D(2,1079) | ... .. | D(960,1079) | ... .. | D(1919,1079) | D(1920,1079) |
| D(1,1080) | D(2,1080) | ... .. | D(960,1080) | ... .. | D(1919,1080) | D(1920,1080) |

## e. Backlight Unit

## e.1 Absolute Maximum Ratings ( 1 Module LED Circuit )

| Item                   | Value |             | Unit | Note                                          |
|------------------------|-------|-------------|------|-----------------------------------------------|
| Forward current        | If    | 30          | mA   | 1Block / PCB                                  |
|                        | Ifp   | MAX 320     | mA   | tp ≤ 10 ms, Duty cycle = 1/10<br>1Block / PCB |
| Forward Voltage        | Vf    | Max         | V    | 1Block(20LEDs) / PCB                          |
|                        |       | 72          |      |                                               |
|                        | Vfp   | Max         | V    | Duty 35%<br>1Block(20LEDs) / PCB              |
|                        |       | 98          |      |                                               |
| Storage temperature.   |       | -30 ... +70 | °C   |                                               |
| Storage humidity       |       | 95%, 60deg  |      |                                               |
| Operating temperature. |       | -20 ... +70 | °C   |                                               |
| Operating humidity     |       | 95%, 50deg  |      |                                               |

## e.2 Electrical &amp; Optical Characteristics ( at Ta=25 degree )

| Item                  | Symbol | Min.                       | Typ. | Max. | Condition                | Unit |
|-----------------------|--------|----------------------------|------|------|--------------------------|------|
| Brightness            | Nit    |                            | TBD  |      | IF=120mA<br>(Avg 2point) | nit  |
| Viewing Angle         | 2θ1/2  |                            | TBD  |      | -                        | deg  |
| Color Uniformity      | ΔC     | CIE X,Y = ±0.01            |      |      | (Δ2point)                | -    |
| Brightness Uniformity | ΔB     | MIN / MAX > 0.85 (@2point) |      |      | IF=120mA                 | -    |

## e.3 LED Light Bar Characteristics

| Parameter               | Symbol | Value |       |       | Unit             | Note         |
|-------------------------|--------|-------|-------|-------|------------------|--------------|
|                         |        | Min.  | Typ.  | Max.  |                  |              |
| Light Bar Input Voltage | VLED   | 61    | 64    | 67    | V <sub>DC</sub>  | (Duty 100%)  |
| Light Bar Input Current | ILED   |       | 30    | 320   | mA <sub>DC</sub> | Note 1, 2, 3 |
| Power Consumption       | PLED   |       |       | 23.04 | W                | Note 4       |
| LED Life Time           | LBL    | ---   | 30000 | ---   | Hrs              | Note 5       |

Note 1: There are two Light Bars, and the specified current is input LED chip 100% duty current.

Note 2: The sensing current of each Bar is 30mA.

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Note 3: Each light bar have four current sensing strings, so that each light bar input current is 30mA.  
( 30mA x 4 Bar(top) + 30mA x 4 Bar(Bottom) ) = 240mA ( Typ. )

Note 4: PLED = ILED × VLED.

Note 5: The life time is determined as the time at which luminance of the LED becomes 50% of the initial brightness or not normal lighting at the current  $I_{LED}=120mA$  on condition of continuous operating at  $25\pm2^{\circ}C$ .



Pin No : 1(Vin) / 2(NC) / 3(Feedback) / 4(Feedback) / 5(Feedback) / 6(Feedback)



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**C. Optical specifications**

| Item                        | Symbol     | Condition          | Specification |       |       | Unit | Remark     |
|-----------------------------|------------|--------------------|---------------|-------|-------|------|------------|
|                             |            |                    | Min.          | Typ.  | Max.  |      |            |
| Response time               | Tr         | $\theta = 0^\circ$ | -             | 1.5   | 3     | ms   | Note 2     |
|                             | Tf         |                    | -             | 3.5   | 7     |      |            |
|                             | Tr+Tf      |                    | -             | 5     | 10    |      |            |
| Contrast ratio              | CR         | $\theta = 0^\circ$ | 700           | 1000  | -     |      | Note 1,3   |
| Viewing angle               | Top        | $CR \geq 10$       | 70            | 80    | -     | deg. | Note 1,3,5 |
|                             |            | $CR \geq 5$        | 75            | 85    | -     |      |            |
|                             | Bottom     | $CR \geq 10$       | 70            | 80    | -     |      |            |
|                             |            | $CR \geq 5$        | 75            | 85    | -     |      |            |
|                             | Left       | $CR \geq 10$       | 75            | 85    | -     |      |            |
|                             |            | $CR \geq 5$        | 80            | 89    | -     |      |            |
|                             | Right      | $CR \geq 10$       | 75            | 85    | -     |      |            |
|                             |            | $CR \geq 5$        | 80            | 89    | -     |      |            |
| Brightness (Center)         | $Y_L$      |                    | 200           | 250   | -     | nit  | Note 1,4   |
| Color chromaticity(CIE)     | Wx         | $\theta = 0^\circ$ | -0.03         | 0.313 | +0.03 |      | Note 1     |
|                             | Wy         |                    |               | 0.329 |       |      |            |
|                             | Rx         |                    |               | 0.640 |       |      |            |
|                             | Ry         |                    |               | 0.330 |       |      |            |
|                             | Gx         |                    |               | 0.285 |       |      |            |
|                             | Gy         |                    |               | 0.630 |       |      |            |
|                             | Bx         |                    |               | 0.150 |       |      |            |
|                             | By         |                    |               | 0.060 |       |      |            |
| White uniformity (9 points) | $\delta W$ |                    | 0.75          | -     | -     |      | Note 1,6   |
| Cross talk                  | Ct         |                    | -             | -     | 2%    |      | Note 7     |

Note: Ambient temperature = 25°C.

To be measured in dark room after backlight warm up 30 minutes.

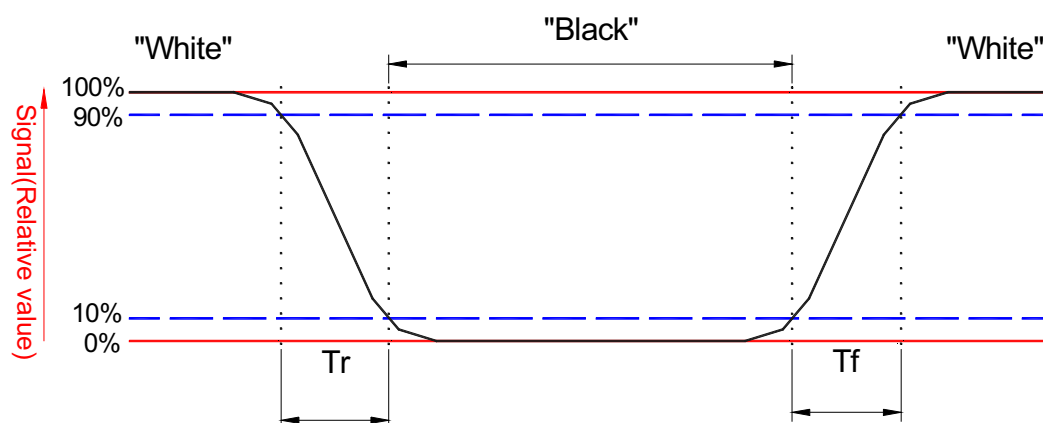
Note 1: To be measured with a viewing cone of 2° by Topcon luminance meter BM-5A.

Note 2: Definition of response time:

The output signals of BM-7 are measured when the input signals are changed from “Black” to “White” (falling time) and from “White” to “Black” (rising time), respectively. The response time interval is between the 10% and 90% of amplitudes. Refer to figure as below.

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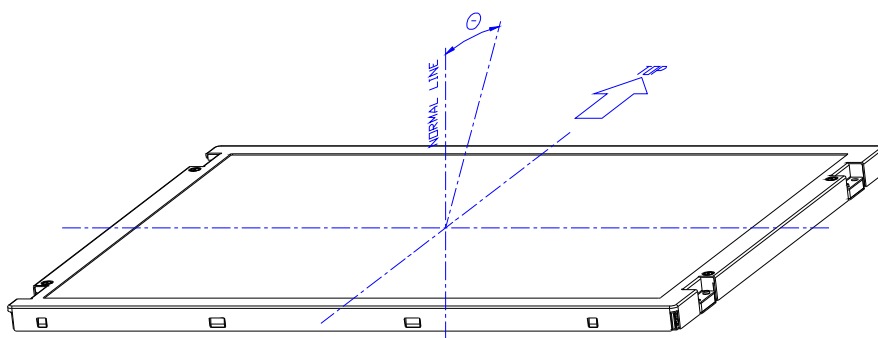
Note 3: Definition of contrast ratio:

Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

Note 4: Driving conditions for LED: White LED IL = 30mA/rms, Vf = 60V

Note 5: Definition of viewing angle



Note 6: Definition white uniformity:

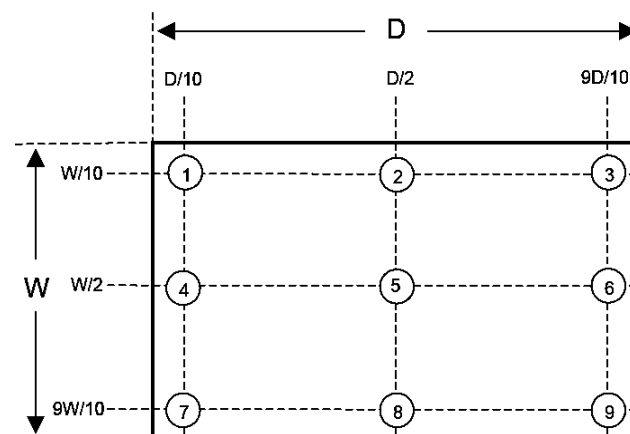
Luminance are measured at the following nine points (P1~P9).

$$\delta_w = \frac{\text{Minimum Brightness of nine points (P1~P9)}}{\text{Maximum Brightness of nine points (P1~P9)}}$$

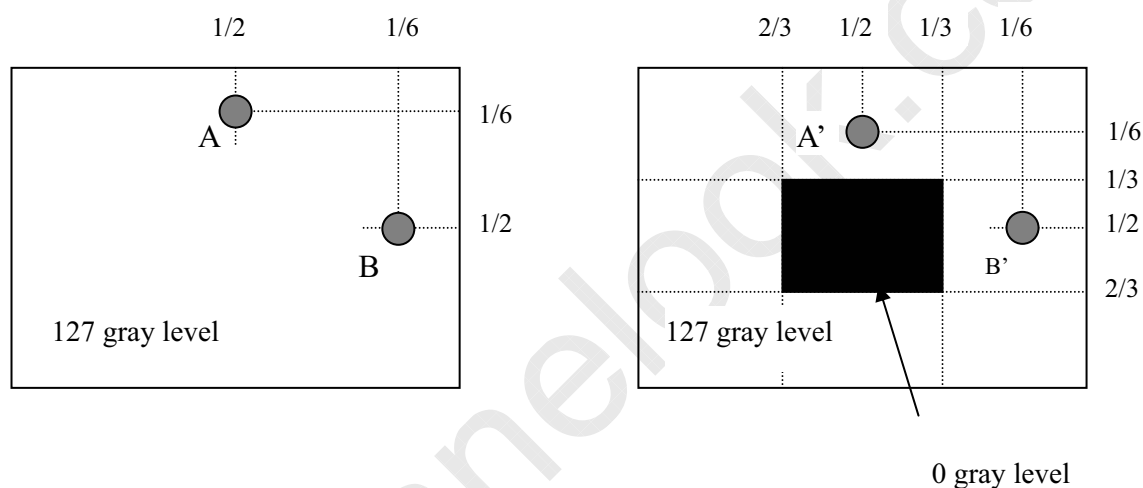


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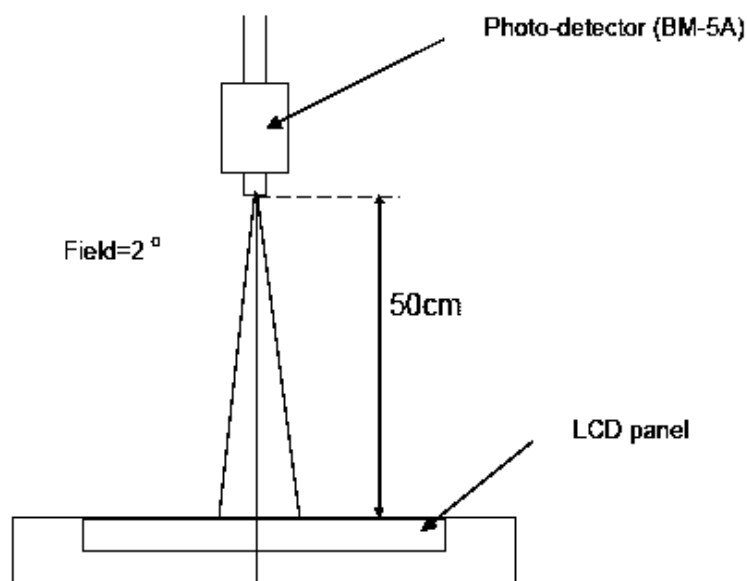


Note 7:


 $|L_A - L_{A'}| / L_A \times 100\% = 2\% \text{ max.}$ ,  $L_A$  and  $L_{A'}$  are brightness at location A and A'

 $|L_B - L_{B'}| / L_B \times 100\% = 2\% \text{ max.}$ ,  $L_B$  and  $L_{B'}$  are brightness at location B and B'

Note 10: Optical characteristic measurement setup.





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## D. Reliability test items

| Test Item                                        | Test Condition                                                                                                                                           | Judgment | Remark |
|--------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|
| High temperature storage                         | 60°C, 240Hrs                                                                                                                                             | Note 1   | Note 2 |
| Low temperature storage                          | -20°C, 240Hrs                                                                                                                                            | Note 1   | Note 2 |
| High temperature & high humidity operation       | 40°C, 90%RH, 240Hrs<br>(No condensation)                                                                                                                 | Note 1   | Note 2 |
| High temperature operation                       | 50°C, 240Hrs                                                                                                                                             | Note 1   | Note 2 |
| Low temperature operation                        | 0°C, 240Hrs                                                                                                                                              | Note 1   | Note 2 |
| Thermal Shock<br>(non-operation)                 | -20°C~60°C,<br>1hrs, 3mins, 1hrs, 100Cycles                                                                                                              | Note 1   | Note 2 |
| Electrostatic discharge (ESD)<br>(non-operation) | Contact: +/-8kV, 150pF(330ohms),<br>25 times/1 point, 1 time/1 sec<br>Air discharge: +/-15kV, 150pF(330ohms),<br>25 times/1 point, 1 time/1 sec          | Note 1   | Note 2 |
| Vibration<br>(non-operation)                     | Vibration level : 1.5G<br>Bandwidth : 10-300Hz<br>Waveform : sine wave,<br>sweep rate : 10min<br>30 min for each direction X, Y, Z<br>(1.5 Hrs in total) | Note 1   | Note 2 |
| Mechanical Shock<br>(non-operation)              | Shock level : 50G, 11ms<br>Waveform : Half sine wave<br>Direction : ±X, ±Y, ±Z<br>One time each direction                                                | Note 1   | Note 2 |
| MTBF Demonstration                               | 50,000 hours with confidence level 90%                                                                                                                   | Note 1   | Note 3 |

Note1: Pass: Normal display image with no obvious non-uniformity and no line defect.

Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

Note2: Evaluation should be tested after storage at room temperature for two hours.

Note 3: The MTBF calculation is based on the assumption that the failure rate distribution meets the Exponential Model.

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## **E. Safety**

### **(1). Sharp Edge Requirements**

There will be no sharp edges or corners on the display assembly that could cause injury.

### **(2). Materials**

#### **a. Toxicity**

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible InnoLux Toxicologist.

#### **b. Flammability**

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process. The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

#### **c. Capacitors**

If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

## **F. Display quality**

The display quality of the color TFT-LCD module should be in compliance with the Innolux's Incoming inspection standard.

## **G. Handling precaution**

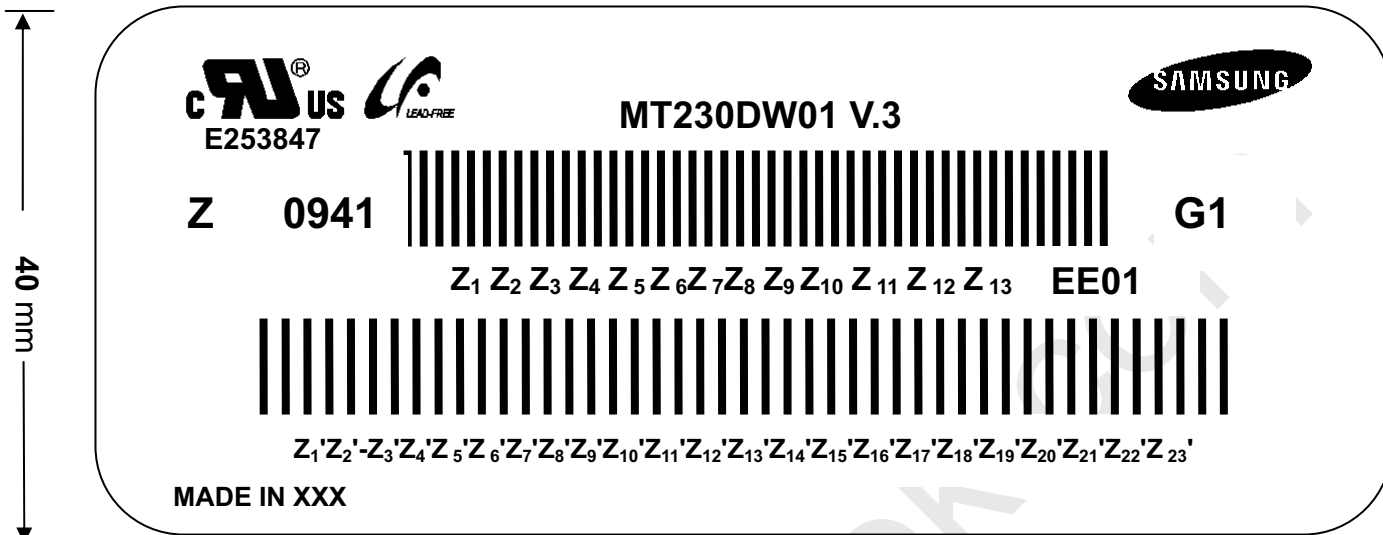
The Handling of the TFT-LCD should be in compliance with the Innolux's handling principle standard.

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**H. Panel Label****(1). Module Label**

80 mm



(a). Model Number: MT230DW01 V.3

(b). Customer Grade Mark : Z

(c). INL Grade: G1 (Code of grade: 1,2,3,5,E)

(d). Week Code: 0941 (YY,WK)

(e). Revision Code: EE01 (Make information + Minor Revision)

(f). Serial ID I: Z<sub>1</sub> Z<sub>2</sub> Z<sub>3</sub> Z<sub>4</sub> Z<sub>5</sub> Z<sub>6</sub> Z<sub>7</sub> Z<sub>8</sub> Z<sub>9</sub> Z<sub>10</sub> Z<sub>11</sub> Z<sub>12</sub> Z<sub>13</sub>

Serial No: Lot No. Panel No

Year, Month, Date

Make information: SDEE

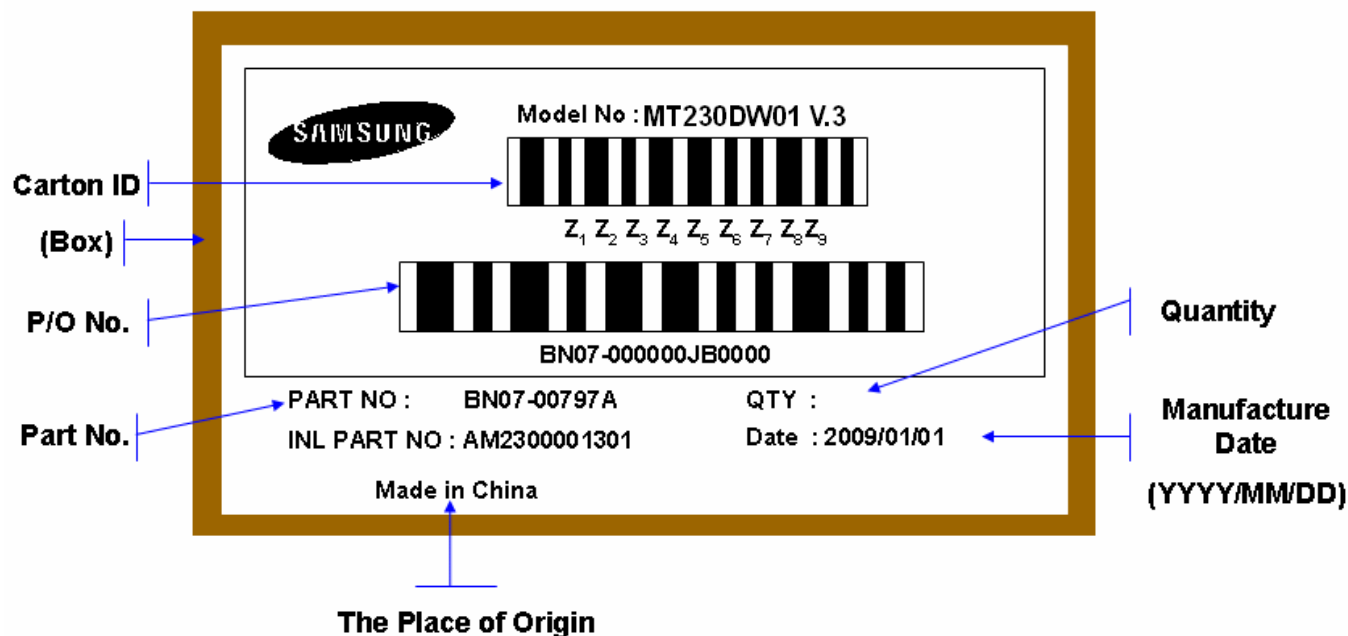
Customer code: V

(g). Serial ID II: PPID (23 digits)

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## (2) Carton Label



(a). Model No. : MT230DW01 V.3

(b). Part No. : BN07-00797A

(c). INL Part No. : AM2300001301

(d). Packing Q'ty: 7 pcs

(e). Date: Manufacture Date

(f). Carton ID: Z<sub>1</sub> Z<sub>2</sub> Z<sub>3</sub> Z<sub>4</sub> Z<sub>5</sub> Z<sub>6</sub> Z<sub>7</sub> Z<sub>8</sub> Z<sub>9</sub>

Serial No

Code of grade

Year, Month, Date

INL internal use

Carton ID includes the information as below:

(d-1). Manufacture Date: Year: 0~9, for 2000 ~2009

Month: 1~9 &amp; A~C for Jan. ~ Dec.

Date: 1~9 &amp; A~Z (exclude I, O, Q, U) for 1st~31th

(d-2). Code of grade: 1, 2, 3, 5, E

(d-3). Serial No: Module packing sequence no.

(g). P/O No. : Customer P/O number.

## I. ME Drawing



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2D File

